**Introduction:** Controversy still exists regarding the location and nature (static or dynamic) of the forearm axis. This might be due to inconsistent results from in-vitro data and less precise methods of analysis. The purpose of this study was to perform an in-vivo study of the forearm, using novel imaging technology, to determine the precise location and nature (dynamic or static) of the axis of the forearm using helical axis parameters.

**Materials and Methods:** Following approval by the IRB, five healthy right-handed volunteers aged from 25 to 37 years (mean, 31.2 years) were enrolled in the study, providing data on ten normal forearms. A custom-made apparatus was designed for this study. Dual rubberized hand grips were mounted on an acrylic frame with attached goniometers. The grips could be locked into a number of rotated positions thus allowing for the precise positioning of the fist in neutral rotation, 60° of pronation, 60° of supination, maximum pronation, and maximum supination. The apparatus was secured to the gantry end of the computed tomographic (CT) scanner table, with the subject’s forearms in the support channels aligned to the longitudinal axis of the CT table (z-axis), and the acrylic frame parallel to the CT gantry plane (x-y plane).

Data was collected using a helical CT scanner. Five helical CT acquisitions were obtained of both forearms simultaneously from the distal humerus to the proximal carpal row. The image data were saved in DICOM format and imported into Analyze 7.0 for data analysis. Pertinent osseous landmarks on the radius and ulna were digitized according to x-y-z coordinates from axial images. These included the ulnar fovea (UF), the center of radial head (CORH) at the proximal radioulnar joint (PRUJ), and the center of ulnar head (COUH) at the distal radioulnar joint (DRUJ). After semi-automatic image segmentation, automatic surface registration was performed of the radius and ulna of the rotated conditions to the segmented bones of the neutral condition. The resultant 4x4 transformation matrices were then input into a custom Matlab program which calculated the finite helical axis (FHA) parameters.

**Results:** The mean FHA for the positions of 60° pronation, 60° supination, maximum pronation, and maximum supination, was determined. The mean FHA was found to extend from the portion of the radial head between its kinematic center and the proximal radioulnar joint, to the dorsal region of the ulnar head at the DRUJ.

**Discussion:** The study presented is the first in-vivo determination of the axis of normal forearm joint rotation using FHA analytic methods in an attempt to resolve the residual uncertainty of the forearm joint axis in terms of its location and nature (static or dynamic). Our study found that the FHAs for forearm rotations were not fixed but varied over a small range. This was in agreement with Nakamura et al.[Nakamura, 1999 #17]. The difference of each discrete FHA varied from the mean FHA by a significant average of 11.8°. This quantified the variability of the axis of the forearm joint and provided further evidence that the instantaneous axis of rotation for the forearm joint was indeed dynamic. The intra-subject variability was remarkably small (mean angular variation of 0.55°, within subjects). This indicated that right-to-left comparative assessment would be useful and most sensitive in detecting kinematic abnormalities of the forearm joint. The symmetry of FHAs in the forearm joint was expected based on previous anatomical studies on skeletal symmetry in the forearm{Swieszkowski, 2001 #78}. The variability of the axes was also consistent with studies that demonstrated the non-circular nature of the radial head{van Riet, 2003 #87;King, 2001 #79}. In conclusion, we were able to precisely locate the axis of the forearm joint using finite helical axis analysis. The sample mean FHA was found to extend from the radial head between its kinematic center and the PRUJ, to the dorsal portion of the ulnar head at the DRUJ.

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